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Paper/Submission ID	1545651
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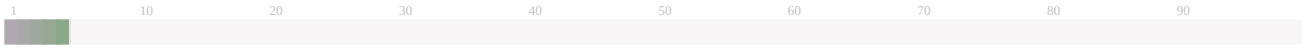

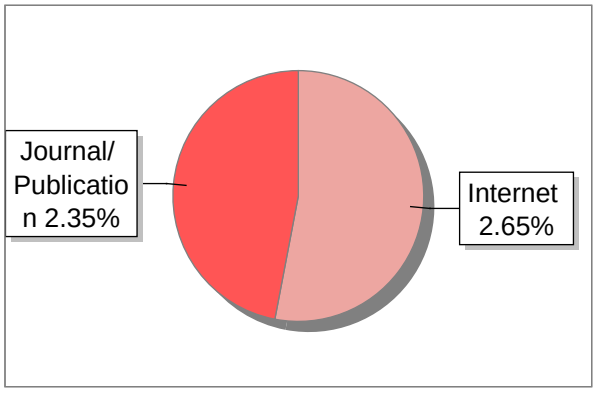

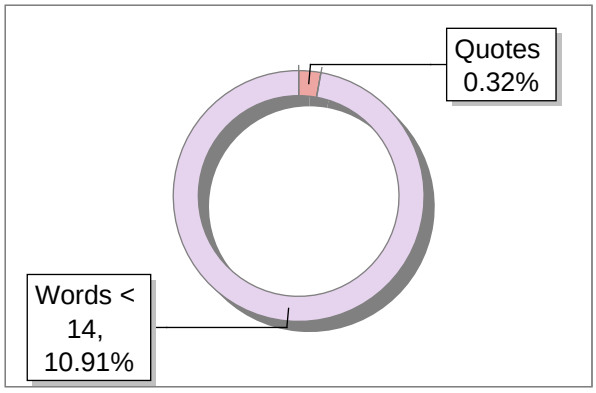

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(Regn. No: SVSU/Ph.D./42177)
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Under the Supervision of

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(NAAC Accredited grade "A" University)
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INTRODUCTION

Outcome Measures and its Significance

Outcome measures or assessment tools are required in every clinical and research settings to find any deviation from what is considered as the typical or normal for the respective variable (1). A clinician's ability to evaluate and analyze a variable is crucial to improving their understanding of normal and impaired activities. This helps them monitor patients' clinical attitudes and develop interventions that are appropriate for each patient (2). Methods of examination and assessment are important for identifying structural and functional constraints, developing an intervention plan, and determining the treatment's outcomes. (3).
The assessment scales or instruments used for the clinical and research purposes should be chosen based on their psychometric qualities and the instrument's suitability for the target group; this can be a difficult process for researchers and clinicians to choose. The tools should be able to assess the changes that they are meant to identify because failing to do so could result in errors in clinical judgment and ultimately impact the patient's rehabilitation.

Prevalence of Balance and Coordination Disorders

Movement performance is impaired by a variety of conditions linked to balance and coordination deficits, including developmental coordination disorder (DCD), cerebellar lesions, attention deficit hyperactivity disorder, and others. Children's prevalence of coordination disorders varies widely depending on the condition. For example, males are more likely than females to be affected by DCD, which has a 1.8% to 8% prevalence according to diagnostic criteria (4). Additionally, 0.03% of children have ataxia as a result of various disorders. Finally, attention deficit hyperactivity disorder (ADHD) has a higher prevalence, ranging from 8% to 15% (5). It was discovered that the frequency of loss of equilibrium and incoordination in adults was 10% in those over 65 and 25–50% in those over 85 (6).

Coordination Tests

There are two types of coordination tests: equilibrium or balance tests and non-equilibrium tests. Non- equilibrium tests used to examine the movement capabilities through limb coordination while equilibrium or balance tests maintain the static and dynamic balance of the body during perturbations (7). For the subject’s assessment, the level of challenges must be increased in these tests which customarily follow some pattern like first of all; activities are to be tested on one side, then to both sides but in proportional and congruous manner. Then it progresses to skew-whiff pattern in both extremities and lastly all four limbs could be involved. Challenges could also be imposed through perturbations or movement transitions (8). There are approximately 16 non-equilibrium tests, also known as tests for limb coordination/movements e.g. Finger to Nose test, Finger to finger test, Pronation-supination test, rebound phenomena, tapping on hand and foot, past pointing test, heel to shin test etc. For posture control there are 25 equilibrium tests such as Sitting in a comfortable position, moving in all directions, standing on single leg, walk on toes, walk on heels, backward and sideways walking, cross-stepping, tandem walking, Romberg’s test, sharpened Romberg’s test etc. Although these are just an approximate figure and are not all-inclusive. To assess coordination in various functional tasks, such as activities of daily living, changing limb or body position, moving from bed to a

wheelchair and back, etc., a variety of techniques can be used. It should be noted that equilibrium tests followed the non-equilibrium tests (9).

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Certain tests can be quantified using specialist instruments such as the Choice Reaction time Analyzer and CATSYS System. Minnesota Manual Dexterity Test, O'Connor Tweezer Test, Finger Dexterity Test, and other tests are used to measure upper limb coordination. The Get-up-and go test, sit-to-stand test, forward reach test, sit-to-stand, one leg standing and other tests are some of the instruments that are used to quantify balance assessments. Many of these tools and instruments are accurate and dependable assessments, and they offer reference values that may be used to compare the abnormal and normal postural control, balance, and coordination (10).

Goals of examination Coordination assessment and examination has been done so as to evaluate the muscles ability to work synchronically to accomplish any functional task, to initiate a movement and then to control and terminate it. The other goals are arrangement, accuracy of movement's pattern and its timing. Also, the peculiarity of muscle activity during voluntary movement along with paraphernalia of pharmacological and therapeutic treatment on motor function over time and the efficiency of movement and skills level are also some of the goals of coordination examination. There are various coordination tests which can assess the ability of an individual to perform an activity or to maintain the posture while performing an activity. Hence, quantification of coordination is of utmost importance for clinicians to academicians as it can enlightens the 6 pathways of the therapeutic interventions as well as provide guidance to provide a thorough assessment of the cardinal and substantive neuromuscular deficits in a potentiate individual. The evaluation and assessment of motor coordination is very essential so as to enhance the knowledge of the normal and the impaired motor activities which further assist in keeping a check on the clinical attitude of the individuals along with the standardization of the treatment protocol.

The coordination of various functional skills, such as activities of daily living, transitions in limb or body position, and the transfer from bed to wheelchair and back, can be assessed using a variety of techniques (11). Any deficits in balance and coordination can lead to activity limitations and participation restrictions, which have a significant impact on an individual's life. Different methods need to be examined to identify coordination impairments in children due to lack of standard coordination assessment tool (12).

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12. **García-Liñeira *et al* (2021)** did a study to establish a tool for evaluating children's postural control. They concluded that the pediatric balance assessment scale is simple to use and allows one to measure the equilibrium state by measuring the accelerations at the center of mass. (24).

13. **Cancer *et al* (2020)** did a study to compare motor tests that includes questionnaire and clinical examination, psychometric properties, and cultural adaptation to relevant developmental norms. Review of assessment tools to measure movement performance in childhood and adolescence, which are often referred to in an international context. Carefully choosing the test to administer is essential for both an early and precise diagnosis and, more crucially, for a successful intervention that would alter the child's motor developmental pathway with motor difficulties. (25).

14. **Apeksha *et al* (2020)** conducted a study to compare the results with those of children with normal hearing sensitivity in order to measure balance function in children with sensorineural hearing loss utilizing tests to examine the vestibulospinal pathway and the vestibular system. The balance assessment test findings showed a definite anomaly in children with sensorineural hearing loss. They concluded that early research is essential because aberrant vestibular and vestibulospinal pathway may hinder a child's motor development. (26)

15. **Verbecque *et al* (2020)** did a study to investigate balance in people with dyspraxia. Journals with high indexing were searched accordingly. They concluded that, in comparison to typical children of their age, children with DCD have stability limits, struggle with postural changes, and perform differently in different areas of balance. (27)

16. **Farhat *et al* (2015)** conducted a study to comprehend how children with and without coordination impairments relate to each other in terms of physical fitness, body composition, and activity tolerance. The study found that there were significant differences in a number of fitness tests between children with and without DCD, and that BMI was associated with strength and exercise tolerance in DCD children relative to normal children. (28)

17. **Eric D *et al* (2013)** did a study to analyse the Physical Performance Test (PPT) in older persons with and without dementia in order to determine limitation of aerobic capacity. They concluded that both the mini-PPT and PPT, which use basic and instrumental everyday activities as test items, are clinically useful tool to assess people in the early stages of AD and for gathering data on their functional performance (10).

18. **Saether *et al* (2013)** did a study to review tools used to assess balance in clinical practice in individuals with cerebral palsy (CP) as well as the relevance of the research that have looked into these aspects. The majority of the measurement properties of the tools had moderate to limited levels of evidence, according to their findings. The categories with the strongest levels of evidence were "maintain balance," "achieve

balance," and "restore balance," for the Trunk Control Measurement Scale and the Level of Sitting Scale, respectively. There was little information available about response. (29).

19. **Christiaan G *et al* (2012)** did a study to determine the 6-meter walk test, Figure-of-Eight walk test, Timed "Up & Go" test, Frailty and Injuries test's relative and absolute test-retest reliability. Gait speed, dynamic balance, functional mobility, static balance, lower-limb strength, and grip strength are all evaluated with these tests, in that order. They concluded that these assessments can be used to detect variations in older adults' physical functioning who have mild to moderate dementia. (20).

20. **Dewey *et al* (2011)** To examine the frequency of problems with developmental coordination in infants with low weight. They found that in children with low birth weights, bronchopulmonary dysplasia, mother usage of steroids, prolonged gestation, and other factors increase the chance of motor deficits. Consequently, it was recommended that while evaluating developmental difficulties, an assessment of motor functions be included. (31).

21. **H.Wilkins' *et al* (2010)** conducted a study to develop a brief physical performance assessment tool that can be reliably used to detect physical impairment in older adults with and without mild dementia. This brief measure of physical function, the mini-PPT, was validated in non-demented and mildly demented participants and correctly classified participants as functional or not using a simple summed score. The mini-PPT offers a simple, low cost tool to assess function in older adults. (32)

22. **Steffen *et al* (2005)** to expand performance values, on balance tests such as the Multi-Directional Reach, Berg Balance, and others by age and gender, as well as a mobility test Physical Performance Test. The study further looked at connections between subject characteristics and test results. The reference value of data for the study's subjects above 80 years of age is limited by the small sample size, and in the regression analysis, gender and age are predictive factors for the dependent variables. (33).

23. **Franjoine *et al* (2003)** conducted a study to determine the Pediatric Balance Scale's (PBS) interrater reliability and test-retest validity. After assessment of children with mild to moderate balance impairments using PBS, they came to conclusion the PBS have good test-retest and interrater reliability (34).

SCIENTIFIC GAP

There are many tools available for assessment of adult physical performance, but none specifically designed for assessing a child's physical function with impaired balance & co-ordination.

AIM

To Develop an Assessment Tool to Check Physical Performance in Children with Impaired Balance and Coordination.

OBJECTIVES

1. To correlate & develop Physical Performance Assessment tool in Children with Impaired Balance and Co-ordination using different parameters.

2. To validate the Physical Performance Assessment tool in Children with Impaired Balance and Co-ordination.

3. To evaluate reliability of Physical Performance Assessment tool in Children with Impaired Balance and Co-ordination taking adequate sample size.

RESEARCH QUESTION

- Need of assessing Physical Performance in children with Impaired Balance and Co-ordination?
- Will the tool be reliable in assessing Physical Performance in children with Impaired Balance and Co-ordination?

HYPOTHESIS

- **Alternate Hypothesis-** The tool is able to assess Physical Performance in Children with Impaired Balance and Co-ordination.

- **Null Hypothesis-** The tool is not able to assess Physical Performance in Children with Impaired Balance and Co-ordination.

METHODOLOGY

Study Design- Cross-sectional study design

Study Location- OPD of Subharti College of Physiotherapy, SVSU, Meerut.

Study Participants- Children with Impaired Balance and Co-ordination

Sampling Method- Purposive

Sample Size- 194

Inclusion Criteria-

- Five to Twelve years of age
- Both Genders
- Mental age not less than two years
- Children who are able to stand independently without upper extremity support
- Etiologies of balance & co-ordination deficits

Exclusion Criteria –

- Attention Deficit Disorder
- Mental Retardation
- Visual & Hearing Impairments
- Recent musculoskeletal injury

Ethical Statement- The protocol will be submitted for approval to university ethics committee (Medical), SVSU, Meerut.

PROCEDURE

This study will Develop, Evaluate and Validate Physical Performance Assessment Tool in Children with Impaired Balance and Coordination. The study will be carried out in following steps: -

- The children should have reference of their consultant doctor or physiotherapist.
- The parents or guardian of the child will be asked for their informed consent before participation.
- Children should have functional limitations and/or disability that are presented, clinically, as an impaired state of balance & co-ordination.
- General Physical and Neurological examination of children will be done.
- Specific tasks/activities will be compiled together to form a tool for assessing Physical Performance of the children with impaired balance & coordination.
- Pilot study will be done.
- Experts will validate the tool once it has been developed.
- Testing of its reliability will be done using Test-retest reliability and Interrater reliability.

DATA ANALYSIS-

- Use of Paired t test and ANOVA will be done to analyse the data.
- Normality of the data will be checked.
- SYSTAT 13.2 will be used for statistical analysis. The p value < 0.05 will be considered statistically significant.

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11. **Elbasan *et al* (2022)** conducted a study to assess sensory integration and day-to-day activities in children with coordination issues and concluded that children affected with dyspraxia can become more independent in performing their day- to-day activities with the help of special education and rehabilitation programs that include activities to improve motor performance and sensory integration. (23).

12. **García-Liñeira *et al* (2021)** did a study to establish a tool for evaluating children's postural control. They concluded that the pediatric balance assessment scale is simple to use and allows one to measure the equilibrium state by measuring the accelerations at the center of mass. (24).

13. **Cancer *et al* (2020)** did a study to compare motor tests that includes questionnaire and clinical examination, psychometric properties, and cultural adaptation to relevant developmental norms. Review of assessment tools to measure movement performance in childhood and adolescence, which are often referred to in an international context. Carefully choosing the test to administer is essential for both an early and precise diagnosis and, more crucially, for a successful intervention that would alter the child's motor developmental pathway with motor difficulties. (25).

14. **Apeksha *et al* (2020)** conducted a study to compare the results with those of children with normal hearing sensitivity in order to measure balance function in children with sensorineural hearing loss utilizing tests to examine the vestibulospinal pathway and the vestibular system. The balance assessment test findings showed a definite anomaly in children with sensorineural hearing loss. They concluded that early research is essential because aberrant vestibular and vestibulospinal pathway may hinder a child's motor development. (26)

15. **Verbecque *et al* (2020)** did a study to investigate balance in people with dyspraxia. Journals with high indexing were searched accordingly. They concluded that, in comparison to typical children of their age, children with DCD have stability limits, struggle with postural changes, and perform differently in different areas of balance. (27)

16. **Farhat *et al* (2015)** conducted a study to comprehend how children with and without coordination impairments relate to each other in terms of physical fitness, body composition, and activity tolerance. The study found that there were significant differences in a number of fitness tests between children with and without DCD, and that BMI was associated with strength and exercise tolerance in DCD children relative to normal children. (28)

17. **Eric D *et al* (2013)** did a study to analyse the Physical Performance Test (PPT) in older persons with and without dementia in order to determine limitation of aerobic capacity. They concluded that both the mini-PPT and PPT, which use basic and instrumental everyday activities as test items, are clinically useful tool to assess people in the early stages of AD and for gathering data on their functional performance (10).

18. **Saether *et al* (2013)** did a study to review tools used to assess balance in clinical practice in individuals with cerebral palsy (CP) as well as the relevance of the research that have looked into these aspects. The majority of the measurement properties of the tools had moderate to limited levels of evidence, according to their findings. The categories with the strongest levels of evidence were "maintain balance," "achieve

balance," and "restore balance," for the Trunk Control Measurement Scale and the Level of Sitting Scale, respectively. There was little information available about response. (29).

19. **Christiaan G *et al* (2012)** did a study to determine the 6-meter walk test, Figure-of-Eight walk test, Timed "Up & Go" test, Frailty and Injuries test's relative and absolute test-retest reliability. Gait speed, dynamic balance, functional mobility, static balance, lower-limb strength, and grip strength are all evaluated with these tests, in that order. They concluded that these assessments can be used to detect variations in older adults' physical functioning who have mild to moderate dementia. (20).

20. **Dewey *et al* (2011)** To examine the frequency of problems with developmental coordination in infants with low weight. They found that in children with low birth weights, bronchopulmonary dysplasia, mother usage of steroids, prolonged gestation, and other factors increase the chance of motor deficits. Consequently, it was recommended that while evaluating developmental difficulties, an assessment of motor functions be included. (31).

21. **H.Wilkins' *et al* (2010)** conducted a study to develop a brief physical performance assessment tool that can be reliably used to detect physical impairment in older adults with and without mild dementia. This brief measure of physical function, the mini-PPT, was validated in non-demented and mildly demented participants and correctly classified participants as functional or not using a simple summed score. The mini-PPT offers a simple, low cost tool to assess function in older adults. (32)

22. **Steffen *et al* (2005)** to expand performance values, on balance tests such as the Multi-Directional Reach, Berg Balance, and others by age and gender, as well as a mobility test Physical Performance Test. The study further looked at connections between subject characteristics and test results. The reference value of data for the study's subjects above 80 years of age is limited by the small sample size, and in the regression analysis, gender and age are predictive factors for the dependent variables. (33).

23. **Franjoine *et al* (2003)** conducted a study to determine the Pediatric Balance Scale's (PBS) interrater reliability and test-retest validity. After assessment of children with mild to moderate balance impairments using PBS, they came to conclusion the PBS have good test-retest and interrater reliability (34).

SCIENTIFIC GAP

There are many tools available for assessment of adult physical performance, but none specifically designed for assessing a child's physical function with impaired balance & co-ordination.

AIM

To Develop an Assessment Tool to Check Physical Performance in Children with Impaired Balance and Coordination.

OBJECTIVES

1. To correlate & develop Physical Performance Assessment tool in Children with Impaired Balance and Co-ordination using different parameters.

2. To validate the Physical Performance Assessment tool in Children with Impaired Balance and Co-ordination.

3. To evaluate reliability of Physical Performance Assessment tool in Children with Impaired Balance and Co-ordination taking adequate sample size.

RESEARCH QUESTION

- Need of assessing Physical Performance in children with Impaired Balance and Co-ordination?
- Will the tool be reliable in assessing Physical Performance in children with Impaired Balance and Co-ordination?

HYPOTHESIS

- **Alternate Hypothesis-** The tool is able to assess Physical Performance in Children with Impaired Balance and Co-ordination.

- **Null Hypothesis-** The tool is not able to assess Physical Performance in Children with Impaired Balance and Co-ordination.

METHODOLOGY

Study Design- Cross-sectional study design

Study Location- OPD of Subharti College of Physiotherapy, SVSU, Meerut.

Study Participants- Children with Impaired Balance and Co-ordination

Sampling Method- Purposive

Sample Size- 194

Inclusion Criteria-

- Five to Twelve years of age
- Both Genders
- Mental age not less than two years
- Children who are able to stand independently without upper extremity support
- Etiologies of balance & co-ordination deficits

Exclusion Criteria –

- Attention Deficit Disorder
- Mental Retardation
- Visual & Hearing Impairments
- Recent musculoskeletal injury

Ethical Statement- The protocol will be submitted for approval to university ethics committee (Medical), SVSU, Meerut.

PROCEDURE

This study will Develop, Evaluate and Validate Physical Performance Assessment Tool in Children with Impaired Balance and Coordination. The study will be carried out in following steps: -

- The children should have reference of their consultant doctor or physiotherapist.

- The parents or guardian of the child will be asked for their informed consent before participation.
- Children should have functional limitations and/or disability that are presented, clinically, as an impaired state of balance & co-ordination.
- General Physical and Neurological examination of children will be done.
- Specific tasks/activities will be compiled together to form a tool for assessing Physical Performance of the children with impaired balance & coordination.
- Pilot study will be done.

- Experts will validate the tool once it has been developed.
- Testing of its reliability will be done using Test-retest reliability and Interrater reliability.

DATA ANALYSIS-

- Use of Paired t test and ANOVA will be done to analyse the data.
- Normality of the data will be checked.
- SYSTAT 13.2 will be used for statistical analysis. The p value < 0.05 will be considered statistically significant.